COS20007
Object-Oriented Programming

Topic 06 Part A
Responsibility Driven Design

Learning Outcomes

- The importance of Responsibility Driven Design
- Understanding the three implementation steps in Responsibility Driven Design
- Applying Responsibility Driven Design in practice with a chess game example

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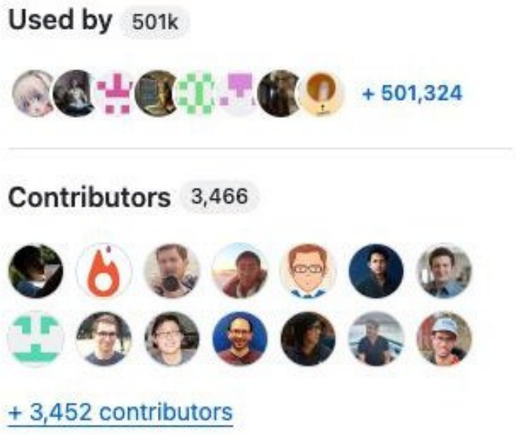
Responsibility Driven Design

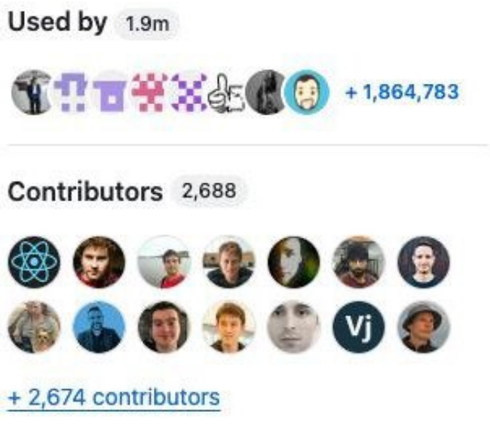
- Software development involves providing instructions for an unintelligent computer

- Developers work in teams to build software solutions, which typically contain millions of instructions

[Pytorch]



[Facebook React]



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Responsibility Driven Design

- Seeing how a solution will work requires clear communication
- Software design documentation before implementation plan
- Effective software design includes picturing the solution and having a common understanding

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Responsibility Driven Design

- How can developers picture the software solution and have a common understanding what the software does?
- How can software designers focus on standard communication protocols within the software, independently of implementation?
- How can we minimize the rework required for major design changes?
- How can we maximize encapsulation when defining blueprint classes?

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Responsibility Driven Design

- Creates effective OO designs using Roles, Responsibilities, and Collaborations
- Design before code = better code + faster written
- Emphasizes behavioral modeling
- Turns software requirements in to OO software

Wirfs-Brock, Rebecca et al. “Object Design: Roles, Responsibilities, and Collaborations.” (2002).

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Step 1: Define the purpose for objects in your program using **Roles**

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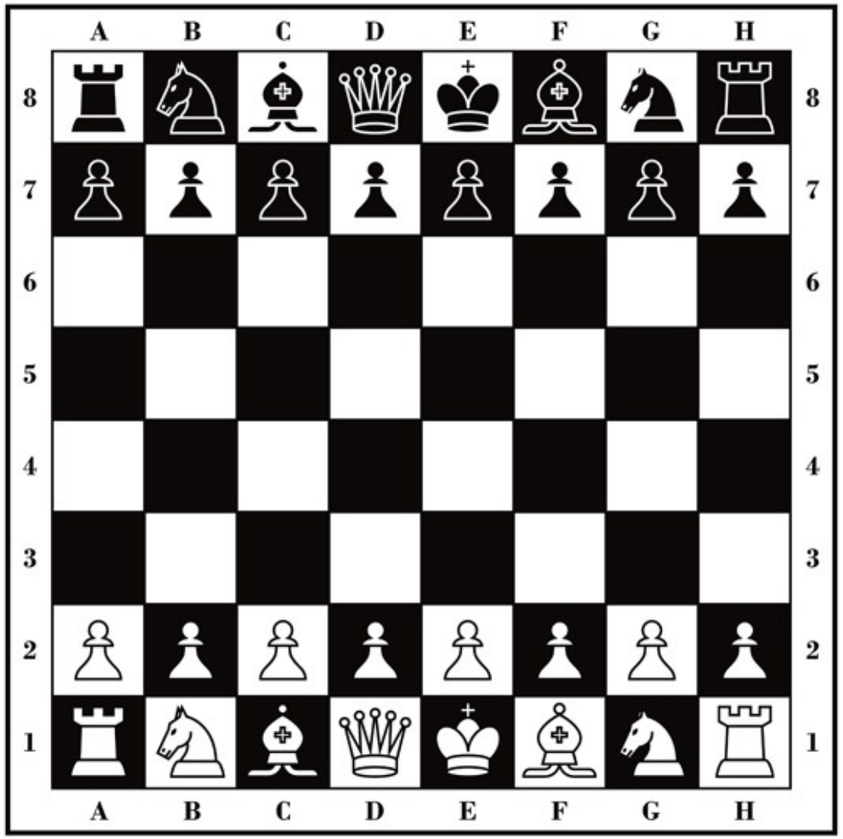
Picture the problem domain and identify **candidate** roles (nouns are a good start)



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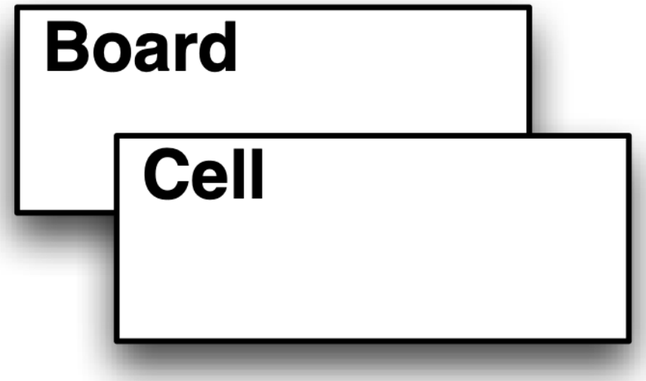
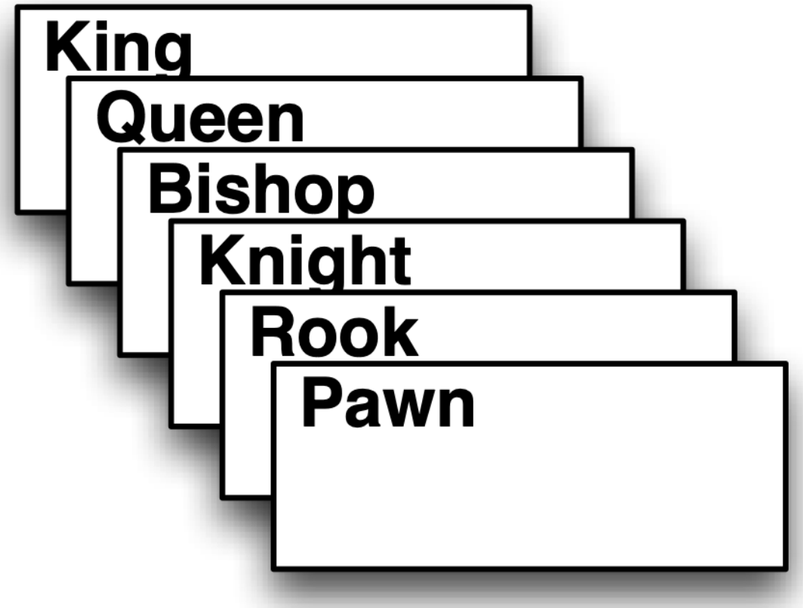
Explore candidate roles using CRC cards





CRC = candidate role, responsibility, collaborations

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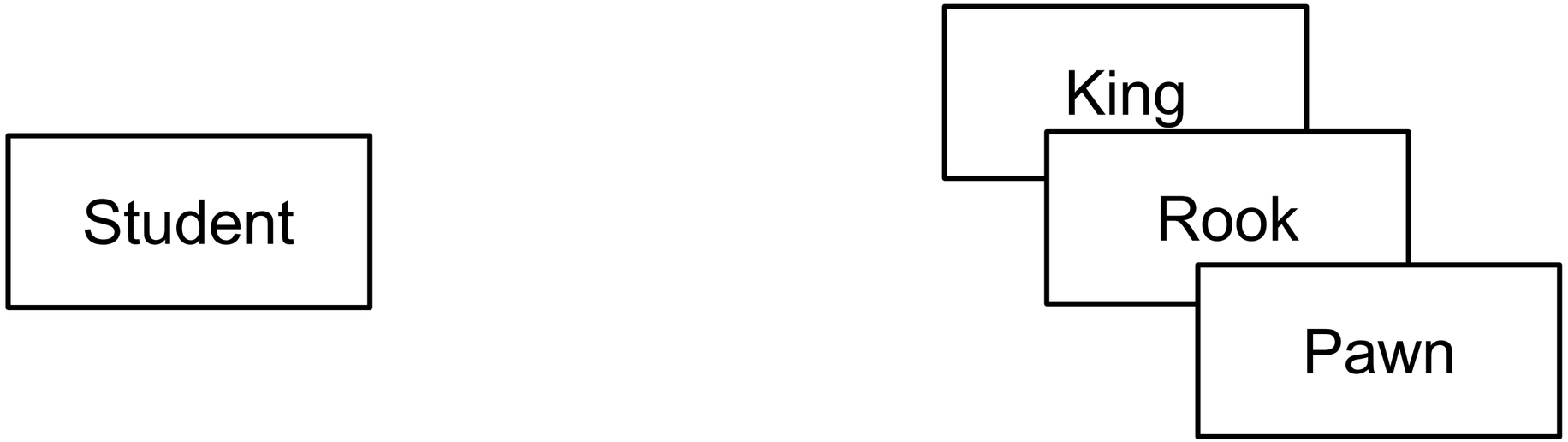
Draw boxes for classes in UML class diagrams to communicate static structure



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Step 2: Define **responsibilities** for each candidate role

- This step often causes you to jump back to the **Step 1**.

- Rethink what roles we really need
- Rethink what roles we do not need anymore
- Some roles may have many (similar) responsibilities

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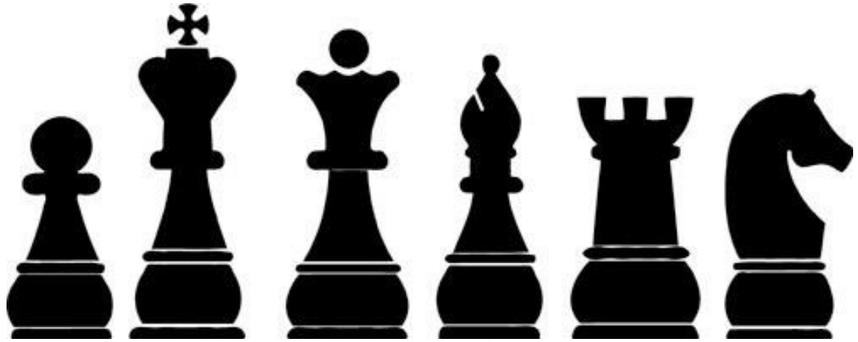
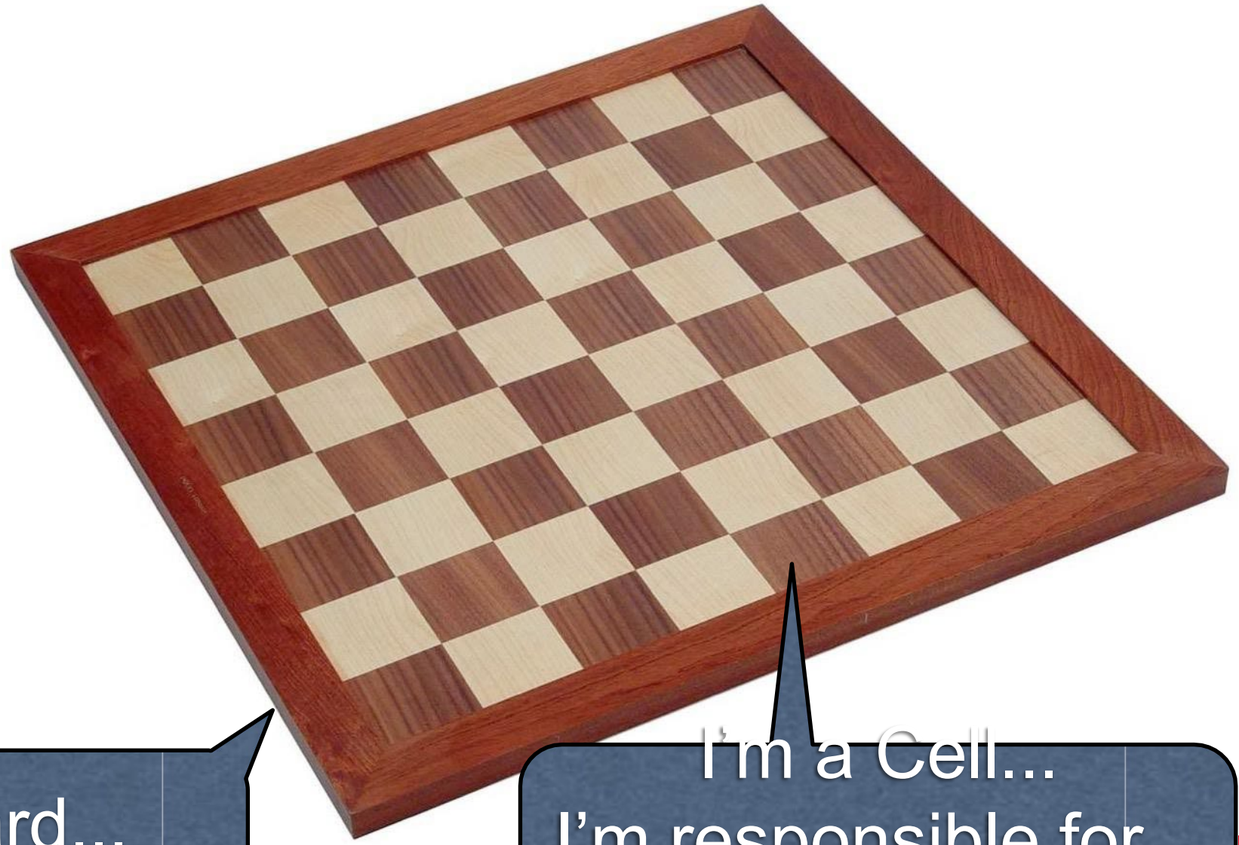
Picture roles as having responsibilities within your overall solution



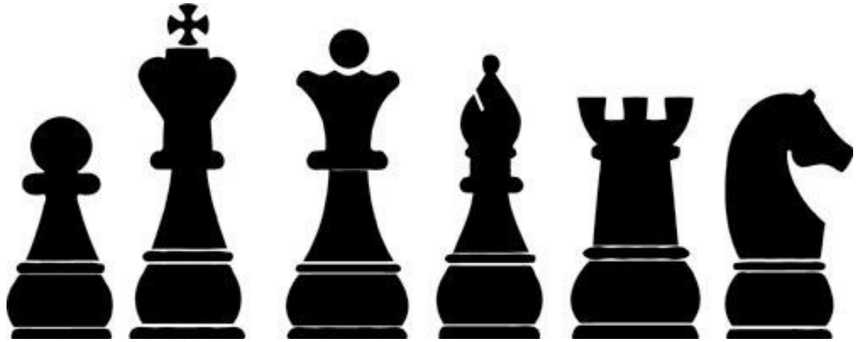
I'm a Bishop...
I'm responsible for...



I'm a Board...
I'm responsible for...

I'm a Cell...
I'm responsible for...

Include responsibilities to **know** things, this forms the data for your program

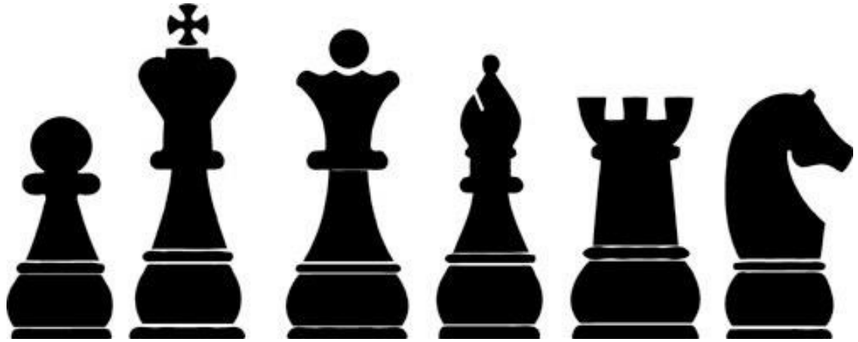


I'm a King...
I know my colour...

I'm a Board...
I know all of the cells.

I'm a Cell...
I know my occupant.

Include responsibilities to **do** things, these become methods in the solution



I'm a Pawn...
I can be a Queen.

I'm a Board...
I can move pieces.

I'm a Cell...
I can hold a piece.

Explore responsibilities using CRC cards

Pawn

knows its color
knows its valid moves
can become a Queen
can take another piece

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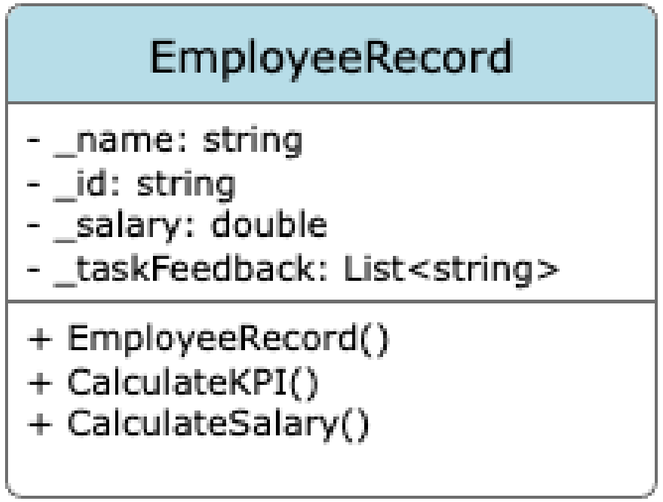
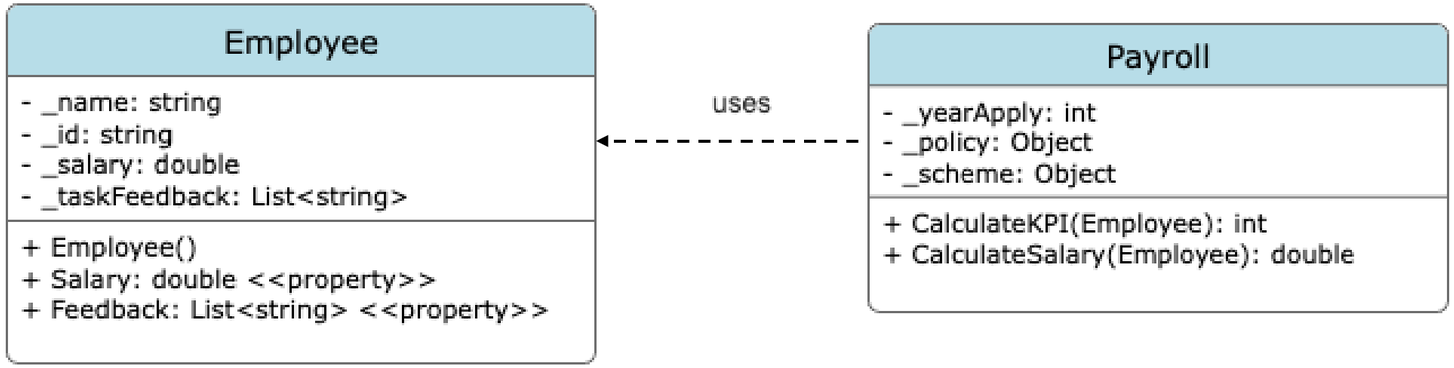
Step 2: Define **responsibilities** for each candidate role

Tips to clarify which roles we really need in our software.

Cohesion: the degree of strongly related functionality are described within the classes



Low Cohesion



High Cohesion

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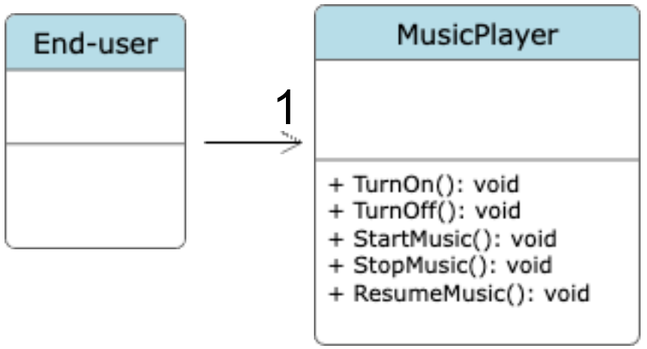
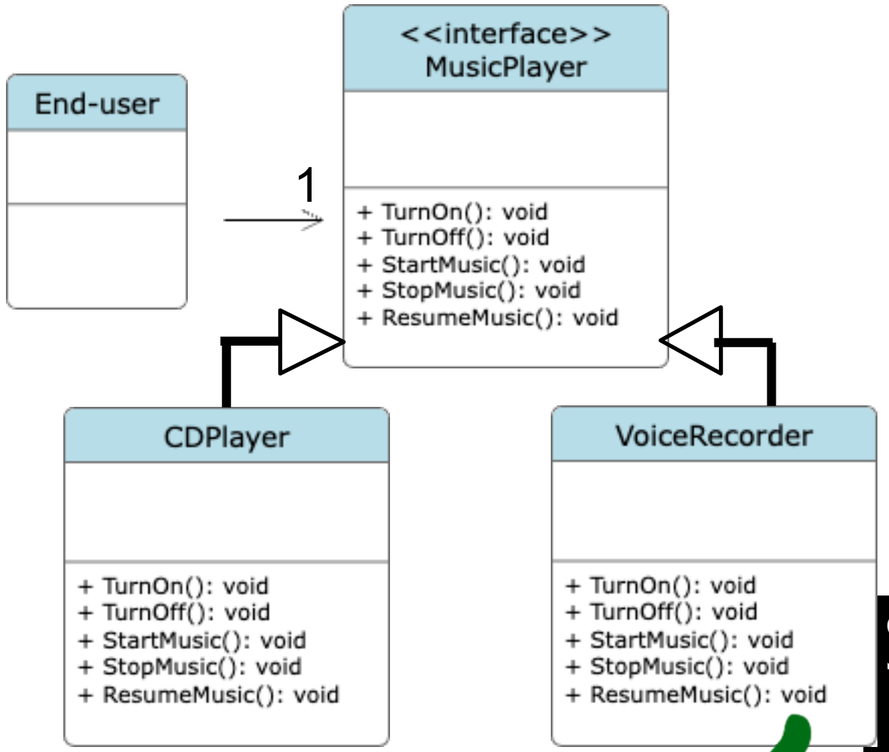
Step 2: Define **responsibilities** for each candidate role

Tips to clarify which roles we really need in our software.

Coupling: the degree of dependence among classes.



Tight Coupling



Loose Coupling

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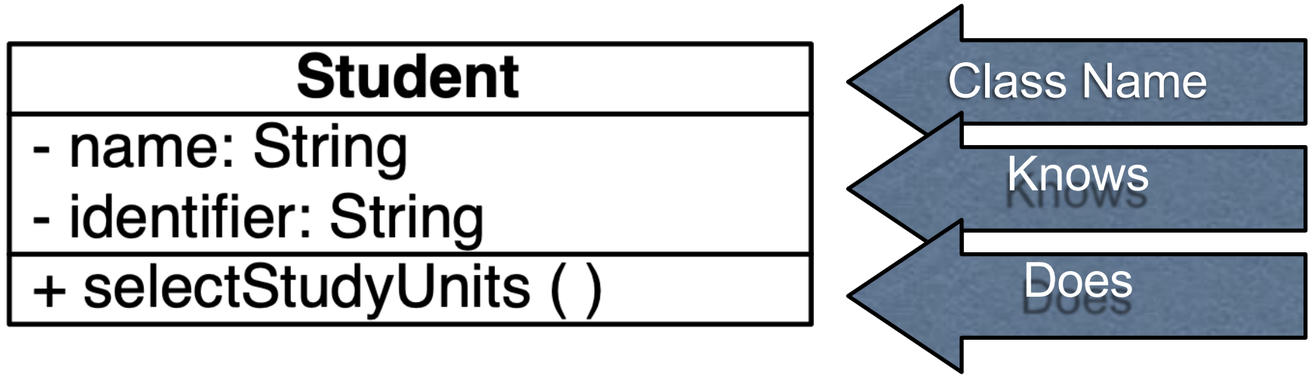
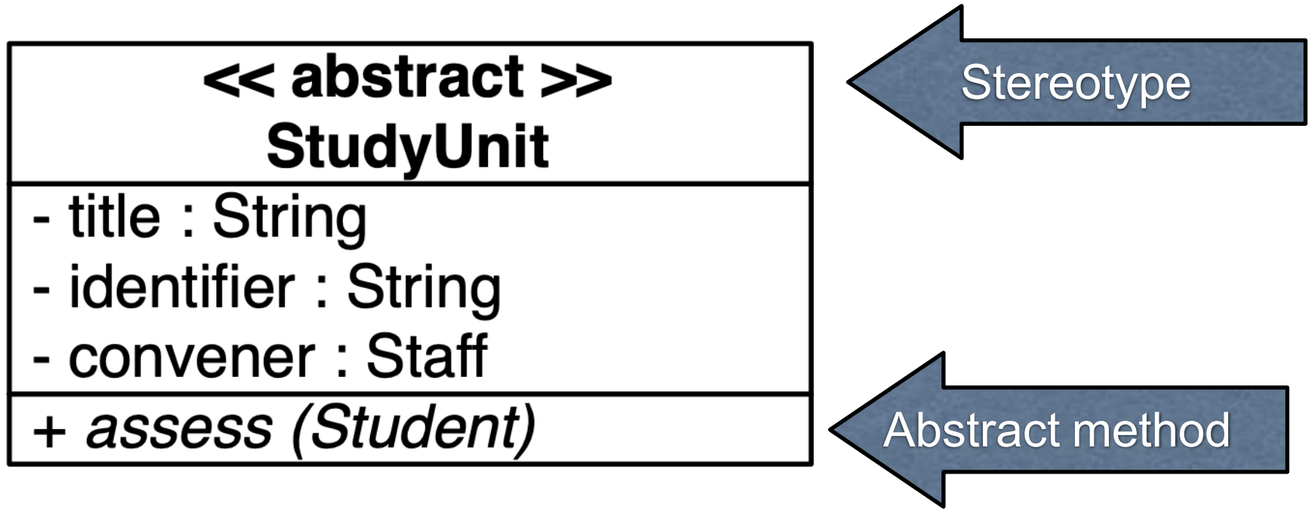
Document responsibilities in UML class diagrams





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Step 3: **Collaborate** with other objects to meet responsibilities

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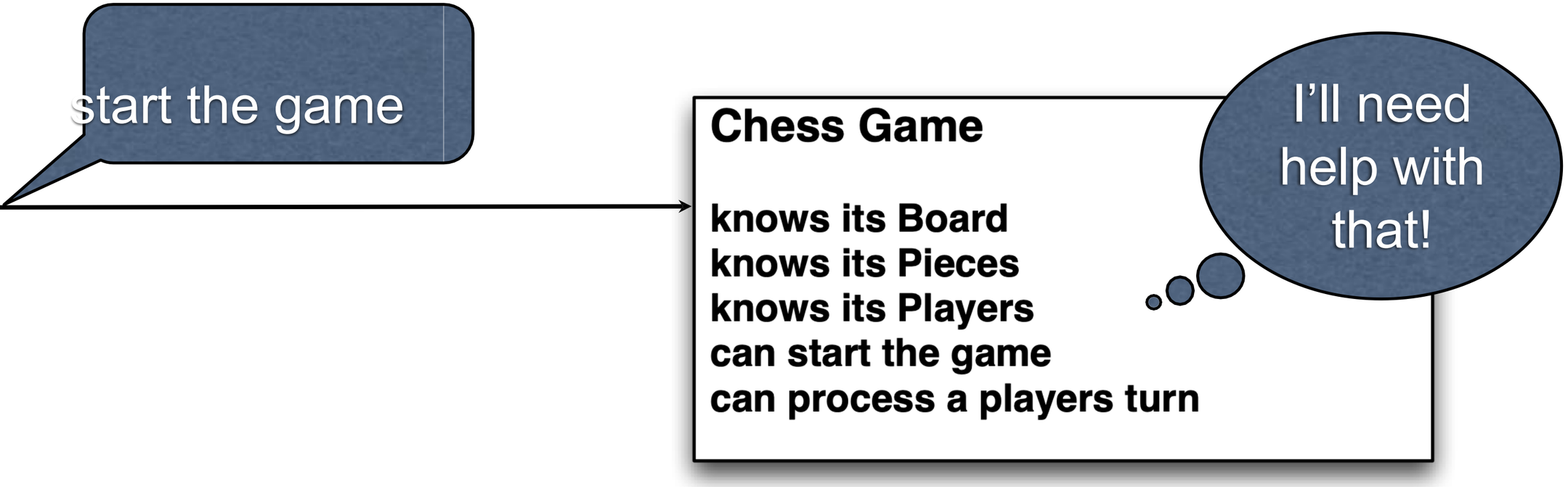
When asked to perform a task, objects can ask others for help



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Think of collaborations as a **client/supplier** interaction or as a contract

Use the different kinds of relationships to help identify possible links

- Association
- Aggregation
- Dependency

→

- where to use
- clarify using software requirement/business analysis

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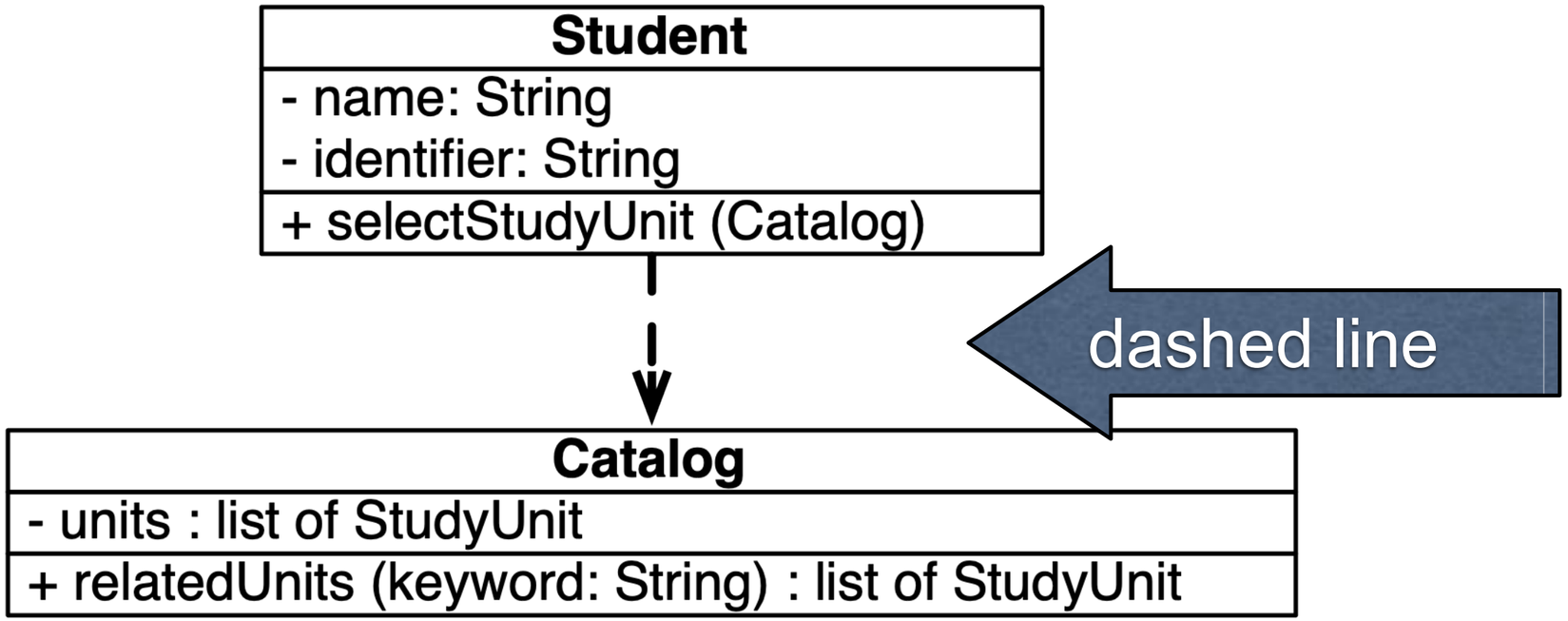
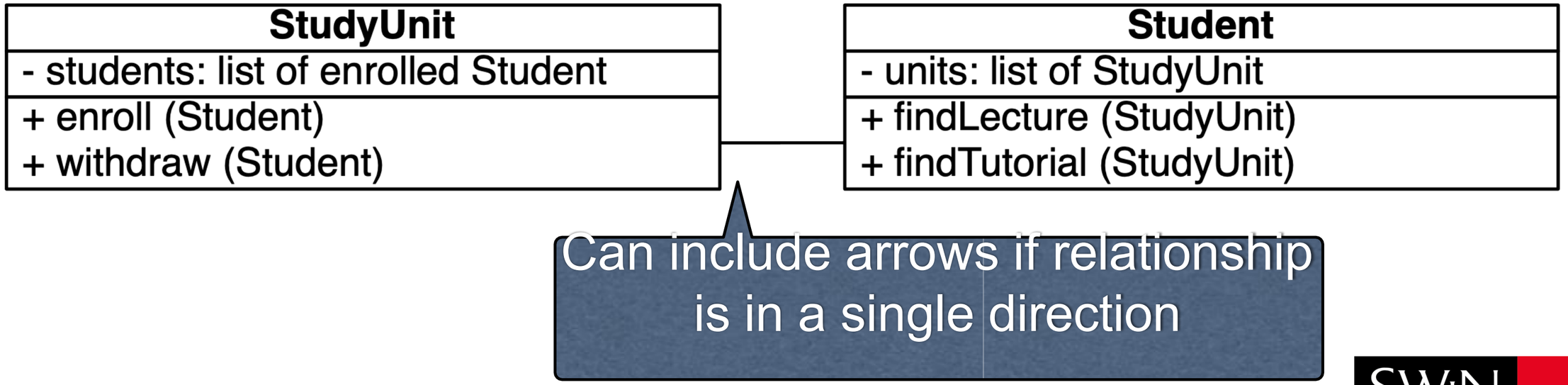
Dependence involves temporary use of another object



Permanent relationships are modelled as association using a solid line in UML



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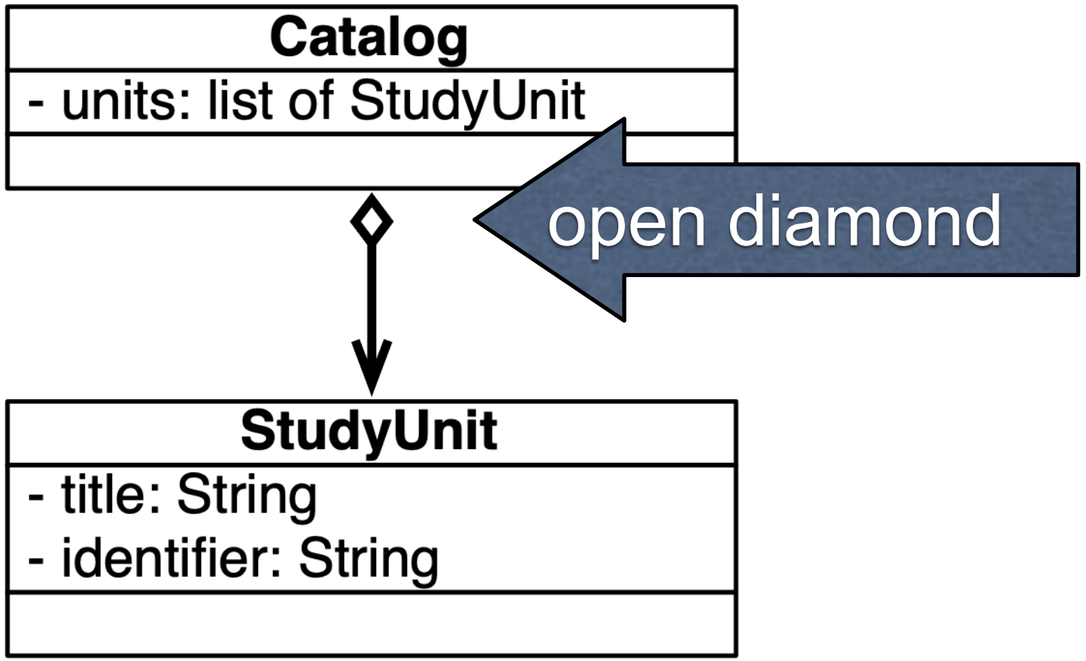
Aggregation extends association to indicate a whole-part relation



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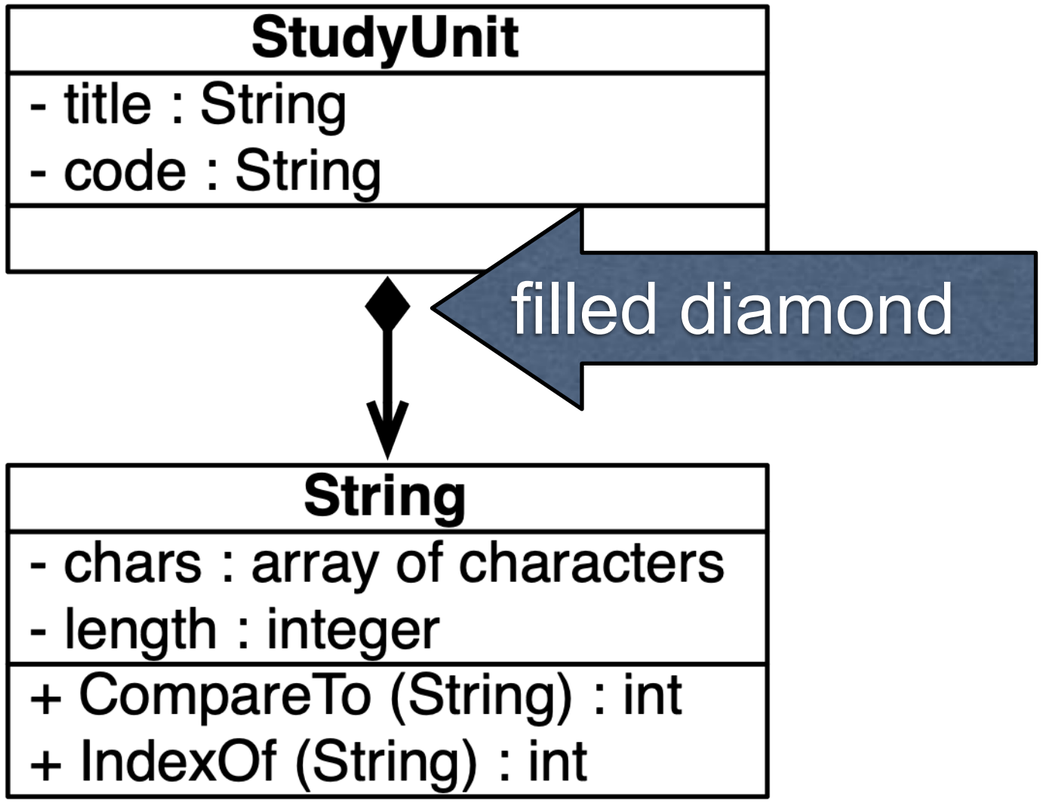
Composition is a kind of aggregation, indicating destruction of the whole involves destruction of the part



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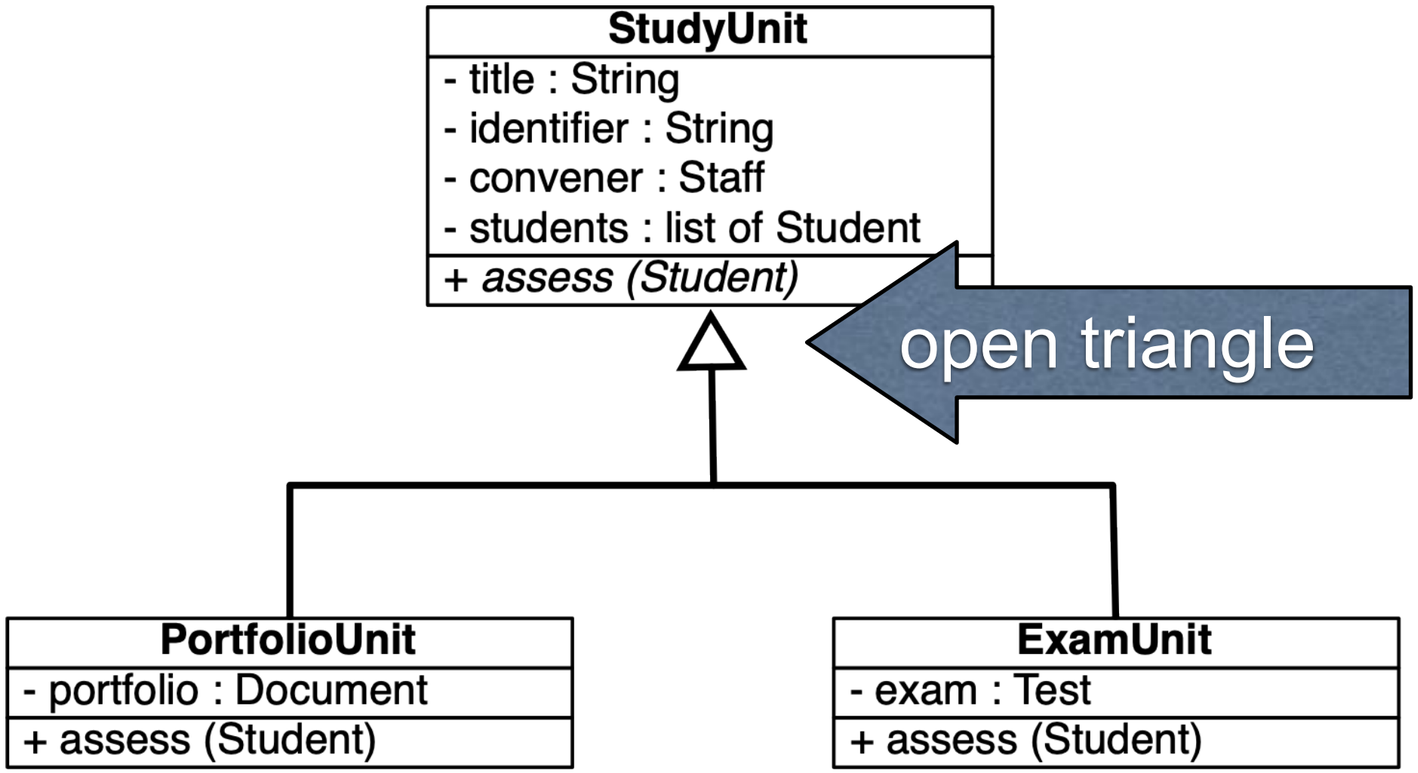
Inheritance captures class and interface inheritance for specialisation/generalisation



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Use scenarios to test how your model responds to events and implements features

Chess Game

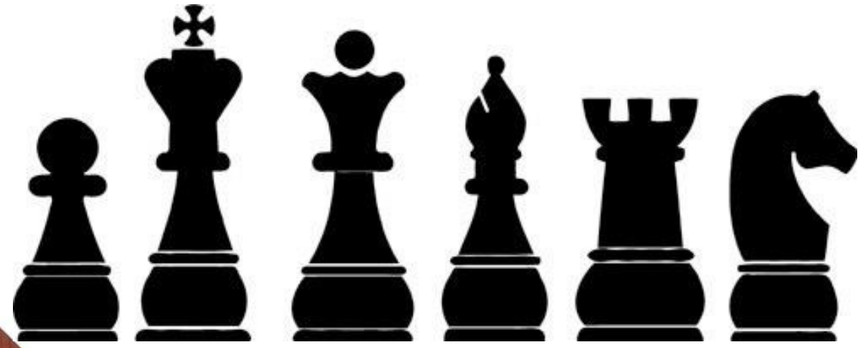
knows its Board
knows its Pieces
knows its Players
can start the game
can process a players turn

Board, setup.

Rook, exist.

Rook, this is your King.

Cell, hold this Rook.



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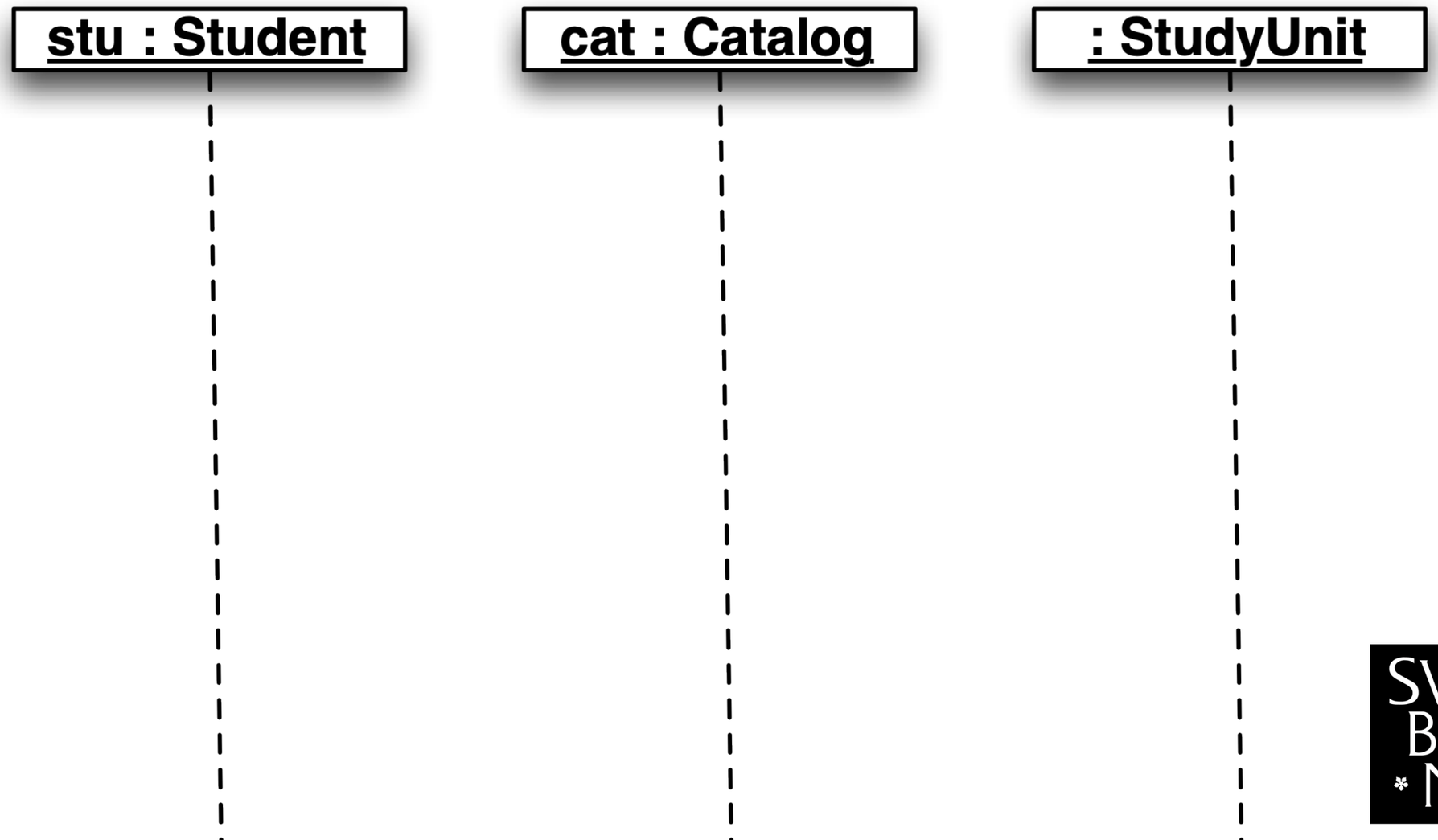
Communicate these dynamic interactions using sequence diagrams

Think of sequence diagrams as scripts, with life lines defining the existence of objects



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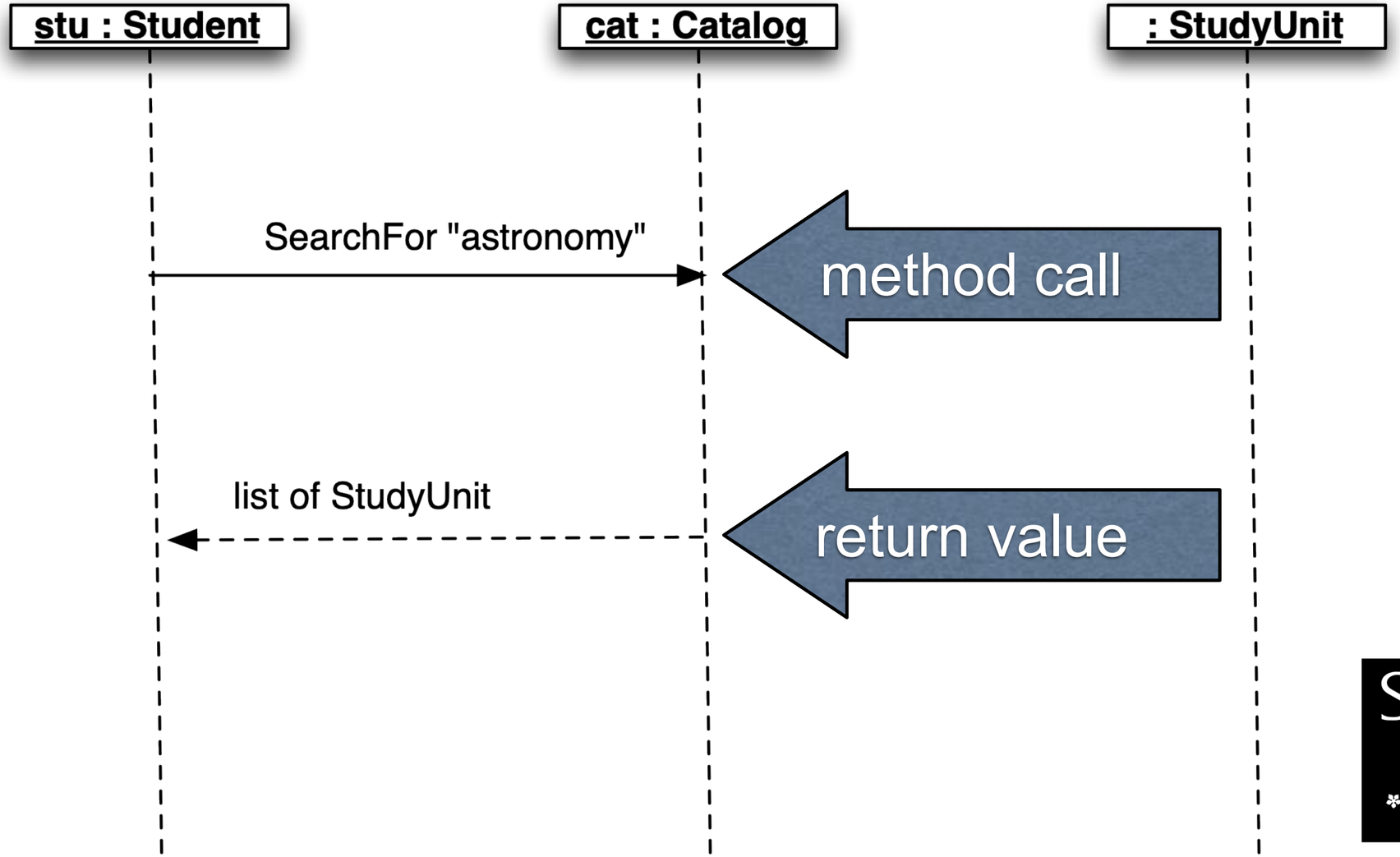
Draw arrows between lifelines to show message passing (method calls)



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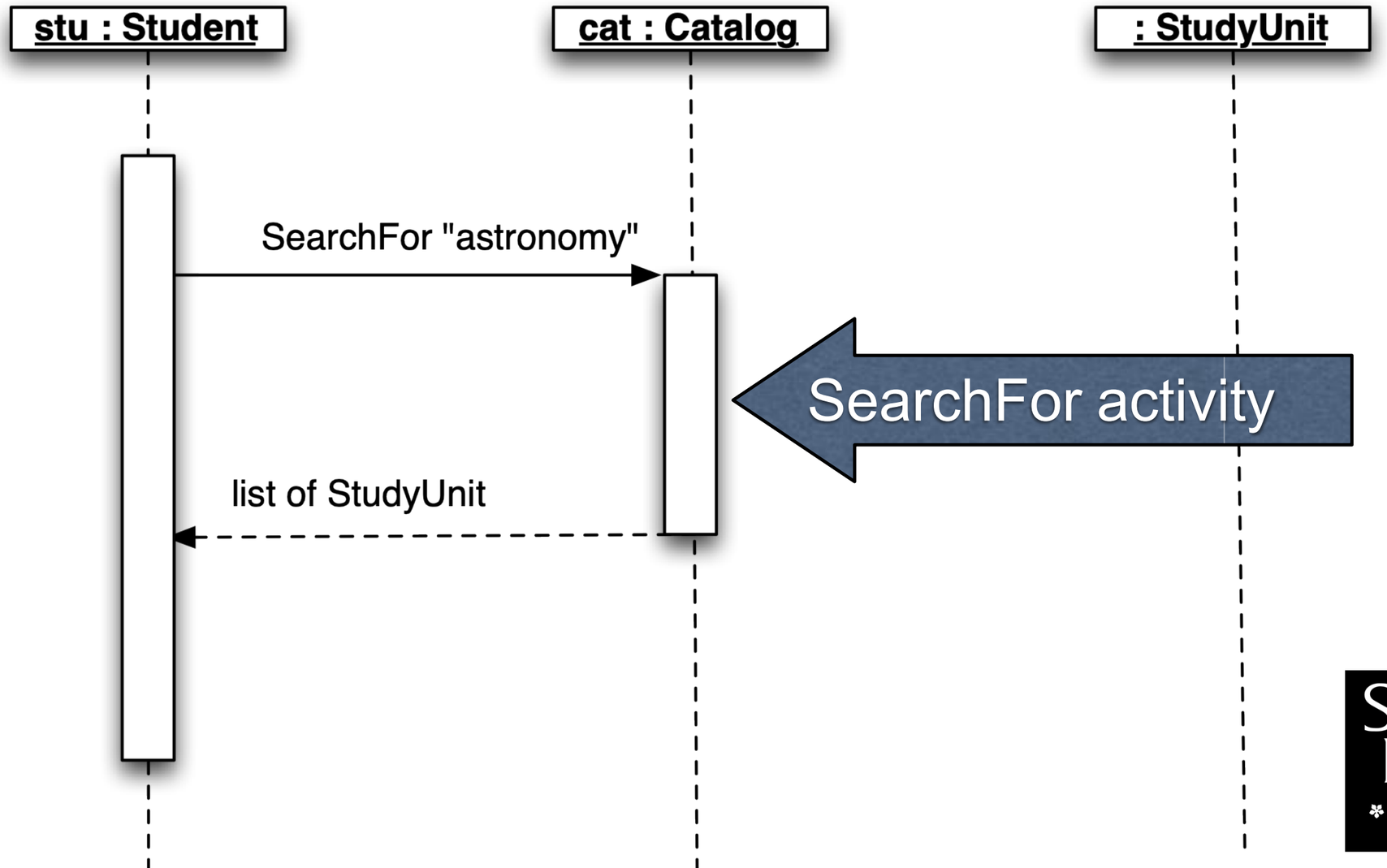
Use boxes to represent **activity**: when it is doing something or waiting for something to be done



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Show control flow logic using **combination fragments**

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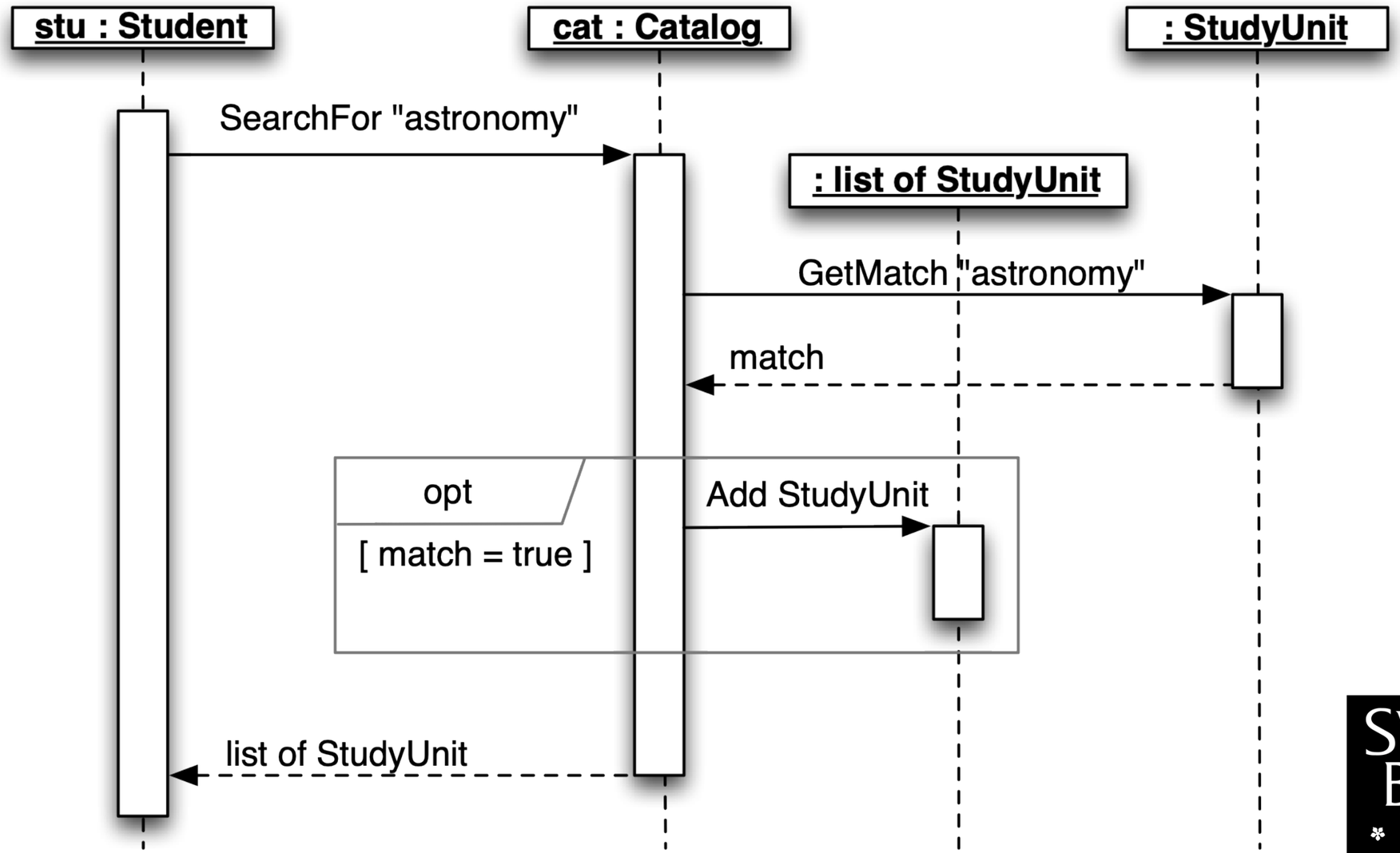
Model if using options



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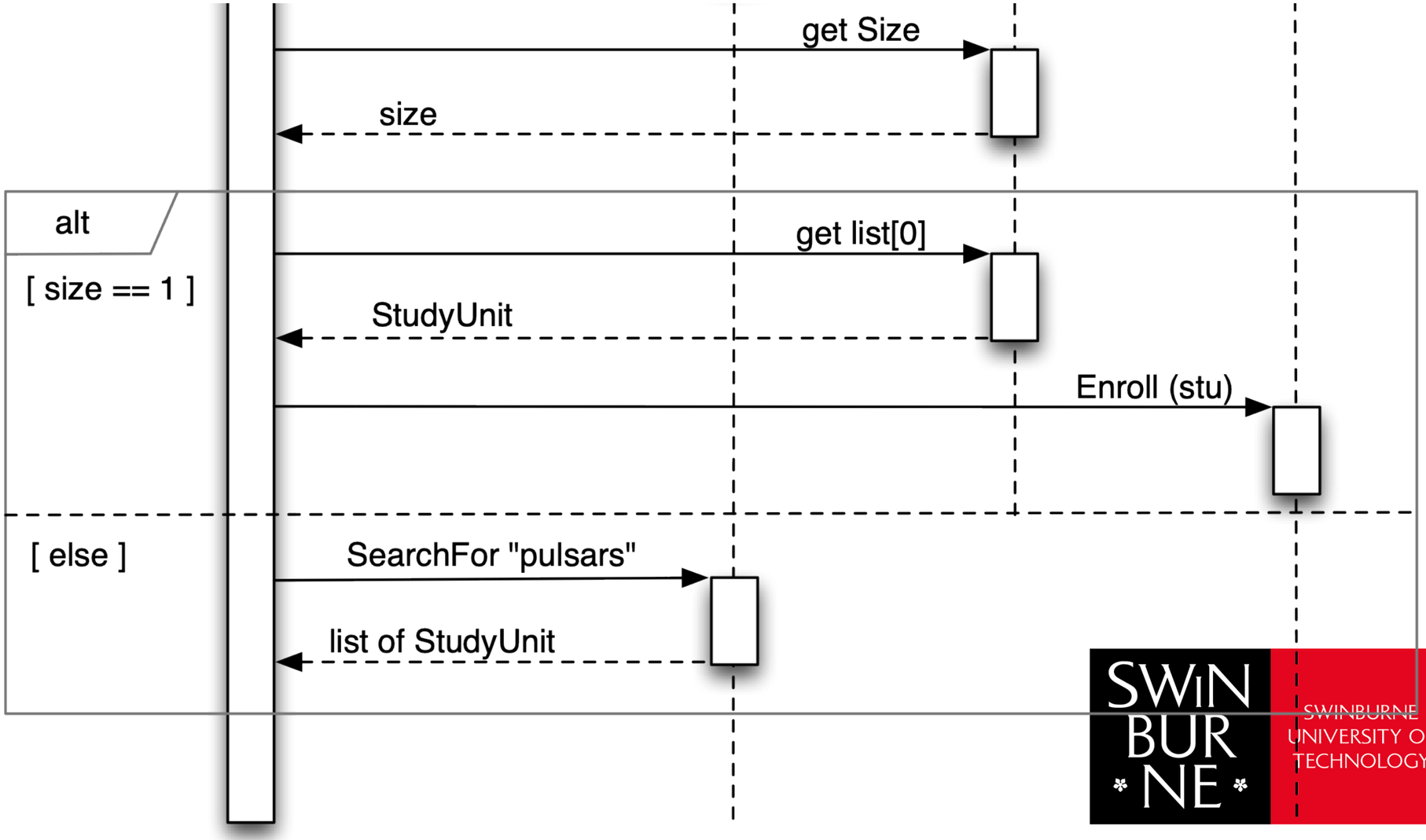
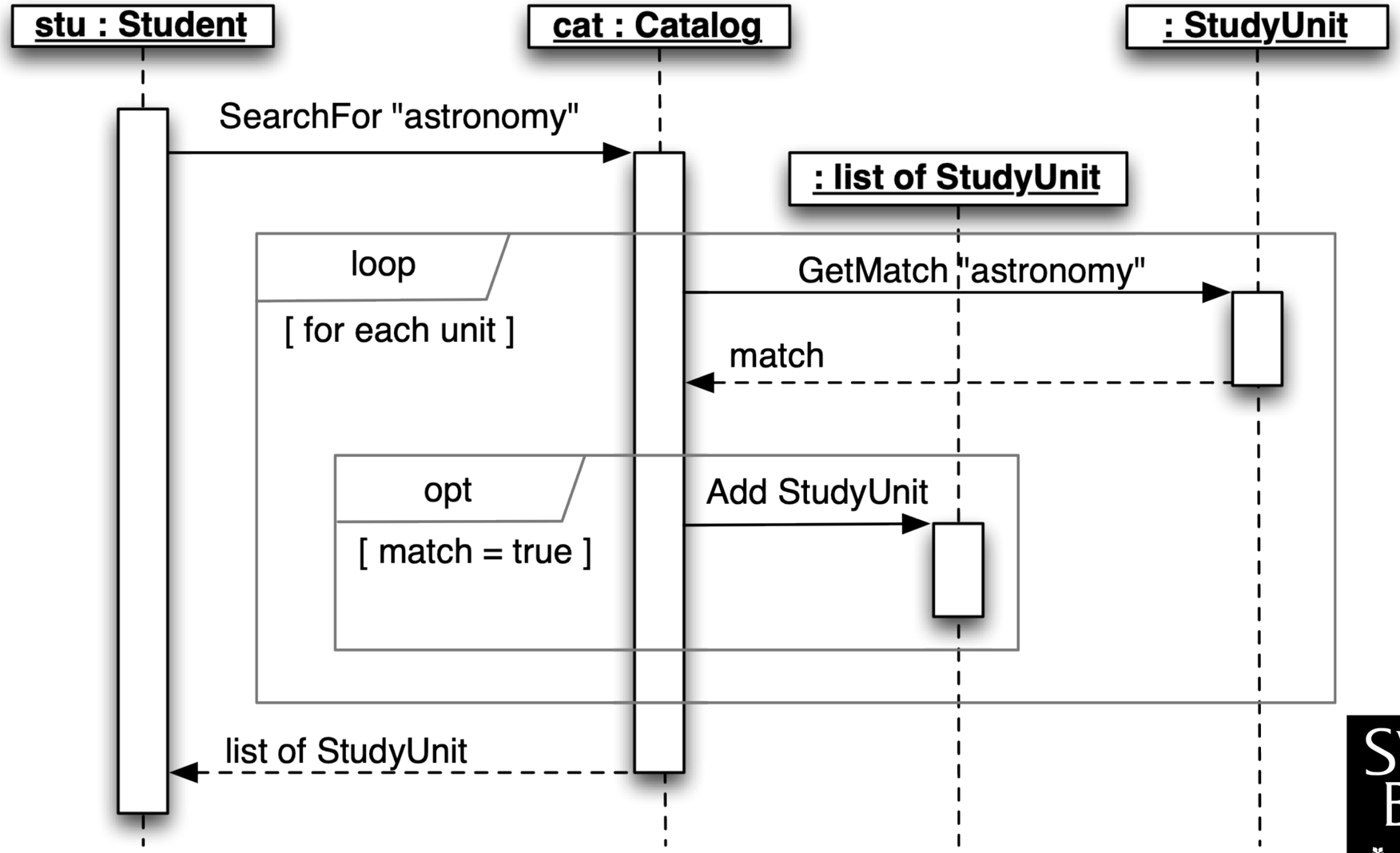
Show alternatives to model if with else



Use loops to model repetition



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Take away message

- Responsibility driven design (RDD) focuses on object roles, responsibilities, and interactions

- There are many role stereotypes in RDD, watch out carefully

https://learn.microsoft.com/en-us/archive/msdn-magazine/2008/august/patterns-in-practice-object-role-stereotypes

- Effective designs ease the process of implementation, for teams and individual developers

- Communication is the key to consolidate understanding what you are building and why you are doing in that way

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